Rhipicephalus rossicus, a neglected tick at the margin of Europe: a review of its distribution, ecology and medical importance

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Abstract. Rhipicephalus rossicus (Ixodida: Ixodidae) is a three-host tick with a broad host spectrum that includes wild animals, pets, livestock and humans. Despite its local abundance in certain areas, most of the information regarding this tick species was published decades ago, mainly by former soviet authors. Its distribution largely overlaps the Eurasian steppe. However, its range may be more extensive than is currently known because this species may have been misidentified as Rhipicephalus sanguineus, principally in areas where the latter species is present. Although R. rossicus has been occasionally reported to feed on people, little attention has been given to its medical importance. It has been shown to have a vectorial role in the transmission of Francisella tularensis, Crimean–Congo haemorrhagic fever virus and West Nile virus. However, the vectorial importance of R. rossicus may be significantly greater, mainly as the closely related species R. sanguineus s.l. is known to transmit a very wide spectrum of pathogens. The probably underestimated vectorial role of R. rossicus may represent a hidden public health threat.

Key words. Rhipicephalus rossicus, Crimean–Congo haemorrhagic fever, seasonal dynamics, tick distribution.

Introduction

Rhipicephalus rossicus Yakimov & Kol-Yakimova, 1911 is a three-host tick with a relatively broad host spectrum that typically inhabits the Eurasian steppe. Despite its local abundance in certain areas, most of the information regarding this tick species was published decades ago, mainly by former soviet authors. Although R. rossicus has been reported occasionally as feeding on people, little attention has been given to its medical importance and vectorial role. After comparing the current distribution of R. rossicus with 50-year-old records from Ukraine, Akimov & Nebogatkin (2013a) concluded that various human activities, as well as climate change, had ‘driven this species deeply into the north’ of the country. A breeding population was found as far north as Kiev (Nebogatkin, 1996), where this tick is commonly reported on dogs (Akimov & Nebogatkin, 2002, 2013b).

Arguably, R. rossicus is listed by DAISIE (Delivering Alien Invasive Species Inventories for Europe) as an alien species in Europe (Roy et al., 2011). In view of its territorial expansion and urbanization, as well as recent findings that R. rossicus may be the dominant tick species to affect pet animals (Dumitrache et al., 2014; Sándor et al., 2014), the aim of this paper is to present a synoptic review of its taxonomic status, host spectrum, geographical distribution, seasonal dynamics and medical importance.

Brief taxonomic overview and notes on key morphological features

Rhipicephalus rossicus is a tick species of the Rhipicephalus sanguineus group. It was initially described as found on...
hedgehogs and rats in the governmental district of Sara-
tov, Russia. The immature stages were described by Shatas
(1956), Olenov (1928) synonymized it with *R. sanguineus*
Zumpt (1939) considered it to be a subspecies of *R. sanguineus*
(*R. sanguineus rossicus*). Currently, it is considered to be a
valid species (Kolonin, 2009; Güglielmon et al., 2010).
Between 1920 and 1930, various Russian authors divided the
*R. sanguineus* group into two different branches: the ‘sanguineus
branch’, and the ‘rossicus branch’ (Morel & Vassiliades, 1963;

Pomerantz (1959) considered *R. rossicus* to be morphologi-
cally close to *Rhipicephalus pumilio*. This close relationship was
also demonstrated genetically by Zahler et al. (1997), who per-
formed molecular analysis using ITS2, a conservative marker
for the genus *Rhipicephalus*, with low variation between species
(Latrofa et al., 2013). This similarity was also highlighted by
Beati & Keirans (2001) and suggested conspecificity between
the two species. However, other molecular markers (i.e. the
mitochondrial 12S of the ribosomal DNA) were demonstrated to
be more useful for phylogenetic analyses (Dantas-Torres et al.,
2013; Latrofa et al., 2013). Sequences of the 12S rDNA are
available for several species of the *R. sanguineus* group (as
defined by Walker et al., 2000), including *R. rossicus*. Based
on these sequences, we have constructed a phylogenetic tree
(Fig. 1) using the maximum parsimony method (Felsenstein,
1985) with the bootstrap test carried out according to the
subtree–pruning–regrafting (SPR) algorithm (Nei & Kumar,
1985) with the bootstrap test carried out according to the
(50% by bootstrap analysis. Phylogenetic analyses
were conducted using MEGA 6 software (Tamura et al.,
2013). The phylogenetic analysis based on the 12S rDNA sequence of
*R. rossicus* suggests that it forms a paraphyletic group. How-
ever, the close relationship of *R. rossicus* with *R. pumilio*, as
demonstrated using ITS2 by Zahler et al. (1997), is sustained
by 12S rDNA.

Because of its close morphological similarities, *R. rossicus* has
probably been misidentified in some reports as *R. sanguineus*,
mainly in cases of ticks collected from dogs in areas in which
the distribution of these two species overlap (Kolonietz, 1936; 
Dumitrache et al., 2014).

However, most of the references cited in this paper originate
from areas outside the distribution range of *R. sanguineus*
and hence the possibilities for misidentification are limited.
Nevertheless, we cannot verify or exclude such events because
no biological material is available and misidentification as
other species (i.e. *Rhipicephalus turanicus* or *R. pumilio*) is also
possible.

### Host spectrum

The host spectrum of *R. rossicus* is relatively wide (Table 1) and
seems to refer to the developmental stage. Overall, *R. rossicus*
has been reported to occur on various groups of mammals
(rodents, carnivores, ungulates, hedgehogs, shrews, hares, humans),
birds (Passeriformes, Galliformes, Falconiformes) and even amphibians. Some host species (shrews, hedgehogs,
rodents and hares) are parasitized by all developmental stages
(Shatas & Bystrova, 1954; Emchuk, 1960, 1967), whereas
others (humans, larger mammals, including domestic animals)
harbour mainly the adults (Shatas & Bystrova, 1954). Domestic
hosts reported include cattle, buffaloes, goats, horses, cats and
dogs. Because of their abundance, several authors consider
hedgehogs and rodents the major hosts for *R. rossicus* (Emchuk,
1960). In rodents and predatory inverteovers inhabiting the
typical habitats of *R. rossicus*, prevalences of tick infestation
may be as high as 80–90% (Shatas & Bystrova, 1954). Despite
intensive sample collection during the summer, Kolomietz
(1936) failed to find *R. rossicus* on reptiles from Ukraine.

An interesting account of the predilection sites of parasitism in
domestic animals was provided by Kolomietz (1936), according
to whom the tick, in horses, is found mainly on the inner side
of the ear pinna, mane region, tail, chest and inner side of
the thighs, whereas in cattle it prefers the ears, udder, perianal
region, external sexual organs, chest, neck and flanks. In dogs
and cats, ticks were collected mostly from the head and ears,
and in pigs *R. rossicus* was found on the ear pinna (Kolomietz,
1936).

*Rhipicephalus rossicus* is a medium-sized tick, slightly larger
than *R. sanguineus* s.l. or other related species (i.e. *R. turanicus*).
It has strong legs, a more rounded body and is usually of
a reddish brown colour. The capitulum is broader than it is
long, the palps are short and broad and the eyes are flat.
*Rhipicephalus rossicus* can be differentiated from closely related
species (e.g. *R. sanguineus* s.l., *R. turanicus, R. pumilio*) by: (a)
the shape of the adanal plates in males (Fig. 2A), which
are very large, posteriorly broad and have a medial spur; (b)
the shape of the spiracular plates in males (Fig. 2B), which
are short and have broad tails; (c) similarly shaped spiracular plates
in females (Fig. 2D), (d) the extensively broad U-shaped
genital aperture in females (Fig. 2C).

### Geographical distribution

The geographical distribution of *R. rossicus* largely overlaps
the area covered by the Eurasian steppe (Fig. 3). It has been
reported from the countries of Armenia, Azerbaijan, Bulgaria,
China, Dagestan, Egypt, Georgia, Iran, Israel, Kazakhstan,
Tajikistan, Moldavia, Poland, Romania, Russia, Turkey, Ukraine
and Uzbekistan. The limits of its distribution are: 31.3–51.3°N
and 23.8–88.1°E. Outside this somewhat compact area of
distribution, isolated sites of occurrence include Moscow, Egypt
(the Sinai peninsula) and Israel. It is not clear if these isolated
reports, which seem to refer to areas outside the species’
distribution range, represent misidentifications or accidental
occurrences on migrating or introduced hosts.

### Seasonal dynamics

Detailed information regarding the seasonality of *R. rossicus*
in Ukraine was provided by Emchuk (1960). Larval and
nymphal parasitism was recorded from March (early spring)
to November (late autumn), with peaks during June–August
(summer). Findings of adults on various hosts occurred all year.
Fig. 1. Phylogenetic analysis based on 12S rDNA of species of the Rhipicephalus sanguineus group (sensu Walker et al., 2000).
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A, adult; L, larva; N, nymph.

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round, peaking from April (mid-spring) to July (mid-summer) (Emchuk, 1960). According to Pomerantzev et al. (1940), adults are active from April (mid-spring) to September (early autumn). Gusev et al. (1962) collected adults from birds in the Kura-Araksinsky lowlands, Azerbaijan in April (mid-spring), June (mid-summer) and November (late autumn). Several authors have reported the maximum peak of activity to occur in June and July (summer) (Shatas, 1956) or May–August (Kolomietz, 1936). Dumitrache et al. (2014) found R. rossicus on dogs in southeastern Romania from April (spring) to August (summer), with a significant peak in occurrence during May–July. Feider (1965) and Coipan et al. (2011) reported adults on rodents and hedgehogs in Romania during May–July, and larvae and nymphs only in July.

Ecology

Shatas (1956) stated that the typical habitats of R. rossicus were ‘bottomland valleys and foothill biotopes’ and that ticks avoid ‘dry habitats’. This preference for river basin valleys was attributed by Shatas & Bystrova (1954) mainly to the richness of available hosts and climate. Emchuk (1967) and Brovko (1969) listed R. rossicus as one of the dominant species in dry artificial
Fig. 2. Key morphological features of *Rhipicephalus rossicus*. (A) Anal plates in males. The arrowhead shows the medial spur. (B) Spiracular plates in males. The arrowhead shows the broad aspect of the tail. (C) Genital aperture in females. The extensively broad U-shape is evident (arrowhead). (D) Spiracular plates in females. The arrowhead shows the broad aspect of the tail.

forests in the steppe zones of southern Ukraine. In Ukraine, the tick is also present in mixed cereal grassland steppe biotopes (Emchuk, 1967). In Transcaucasia, *R. rossicus* was found at altitudes of 40–1112 m a.s.l., in areas with wormwood and grass, lowland liana forests of eastern type, central mountain belts with oak dominance and mountain steppes (Pomerantzev *et al.*, 1940). In the former U.S.S.R. and Romania, *R. rossicus* was found at altitudes of 0–500 m a.s.l. (Feider, 1965). In Bulgaria, Drenski (1955) collected it at 1500 m a.s.l. Kulikoff (1935) found this tick in grasslands, gardens and parks, acacia forests and raspberry bushes.

In a study on the diversity and abundance of ticks from Prikaspiye (in the former U.S.S.R.), *R. rossicus* was listed (together with nine other species) amongst the dominant ticks out of 46 species and subspecies found (Ganiyev, 1966). With regard to dog parasitism, the most interesting occurrences are those in regions in which *R. rossicus* is sympatric with *R. sanguineus* (Fig. 3). In certain localities in these areas of co-occurrence, *R. rossicus* replaced *R. sanguineus* and was reported to be the dominant tick in dogs, mainly in the summer months (Dumitrache *et al.*, 2014). In other localities, *R. sanguineus* and *R. rossicus* occurred on dogs with comparable frequencies (Sándor *et al.*, 2014). This rather remarkable interspecific competition success of *R. rossicus* over other tick species was also recorded in the past. Following the cold winter of 1968–1969 in Rostov Oblast (Russia), the density of the *R. rossicus* population increased three-fold in 1 year, and this species replaced *Hyalomma marginatum* (Ixodida: Ixodidae) as the tick most commonly found on cattle (Badalov *et al.*, 1971). This was attributed to the increased overwinter survival of *R. rossicus* in comparison with *H. marginatum* (Hoogstraal, 1979). Moreover, it has been suggested that *R. rossicus* can also replace *H. marginatum* in its role as an epidemiological vector (Hoogstraal, 1979).

**Lifecycle**

Little is known about the lifecycle of *R. rossicus*. It is a three-host tick, with a natural lifecycle of 2–3 years (Emchuk, 1967; Walker *et al.*, 2000). The relatively long duration of the lifecycle is attributed to the seasonal autonomy of all stages (Belozerov, 1976). The lifecycle was described under laboratory conditions by Kolomietz (1936). Fully engorged females collected from hedgehogs, horses and cattle laid eggs after 5–11 days. Numbers of eggs varied from 200 to 6800 and were correlated with the weight of the females. Larvae hatched from the eggs in 23–26 days. Larvae were experimentally fed on hedgehogs, cats, guinea pigs, dogs and horses. The duration of larval feeding was 1–2 days (Kolomietz, 1936). Pogoreliy (1966) fed larvae using laboratory rabbits and reported the full engorgement and detachment of larvae within 3–5 days. Larvae moulted to nymphs in 8–11 days. The feeding duration of nymphs on experimental animals was 3–4 days. The second moult (nymphs to adults) occurred in 15–20 days. Adults fed on animals for 7–9 days. The total duration of the lifecycle of *R. rossicus* under laboratory conditions was 77–108 days (Kolomietz, 1936). However, Kolomietz (1936) did not provide any information on the temperature and humidity used in his experimental work.
Medical importance

The vectorial capacity of *R. rossicus* has been investigated for only a few pathogens. To date, this species has been shown to have vectorial competence for *Francisella tularensis*, Crimean–Congo haemorrhagic fever (CCHF) virus and West Nile virus (WNV). Other pathogens have been occasionally detected in *R. rossicus*, but its vectorial competence for them has not been demonstrated.

Tularemia

*Rhipicephalus rossicus* is considered to be among the most important vectors for tularemia in steppe zones and floodplain valleys of the former U.S.S.R. (Shatas & Bystrova, 1954; Emchuk, 1967). Detections of *F. tularensis* in *R. rossicus* were reported in the Krasnodar region (Srikhanova et al., 1965), Volgograd Oblast (Borodin et al., 1965), Transcaucasia (Armenia), Azerbaijan, the plains of Central Asia and southern Kazakhstan (Neronov, 1974). The reported prevalence of *F. tularensis* in *R. rossicus* was as low as 1.4% (Balashov, 1987).

The first experimental evidence of the vectorial capacity of *R. rossicus* for *F. tularensis* was provided by Shatas & Bystrova (1954). They showed that *R. rossicus* is able to transmit the agent of tularemia by trans-stadial passage. To date, there is no experimental evidence to indicate the possibility of transvarial transmission of *F. tularensis* by *R. rossicus*. Interestingly, none of the adult ticks infected with *F. tularensis* survived the experimental overwintering, whereas 70% of uninfected control ticks did (Shatas & Bystrova, 1954). This observation might be important if the hypothesis that *F. tularensis* is able to reduce the natural survival of infected ticks is correct.

The significant medical importance of *R. rossicus* as a vector for *F. tularensis* is also related to reservoir hosts which commonly harbour all developmental stages of the tick. Moreover, adult *R. rossicus* can occasionally feed on humans (Shatas & Bystrova, 1954). Olsufev et al. (1963) used the absence of *F. tularensis* in *R. rossicus* and *Dermacentor marginatus* (Ixodida: Ixodidae) collected from cattle as proof of the beneficial impact of the Volgograd hydroelectric power station, which they attributed to the reduction in population density of one of the principal reservoir hosts, *Arvicola terrestris*. Borodin et al. (1958) reported two human cases of allergic reactions after bites of *R. rossicus* infected with *F. tularensis*. The allergic reaction occurred in subjects vaccinated against tularemia.

Crimean–Congo haemorrhagic fever virus

The first isolation of CCHF virus from *R. rossicus* was performed by Chumakov (1969) in ticks collected from cattle and sheep. The principal natural reservoirs of CCHF virus (e.g. hedgehogs, hares, ground squirrels) are also important hosts for *R. rossicus*. Hence, the epidemiological role of this tick in the natural cycle of CCHF virus may be significant (Hoogstraal, 1979). Kondratenko (1976) showed the oral vector competence of *R. rossicus* for CCHF virus and proved its
vertical transmission. The virus was found in *R. rossicus* collected from cattle and *Erinaceus roumanicus* hedgehogs in Rostov region, western Russia (Casals et al., 1970; Kondratenko et al., 1970; Rabinovich et al., 1970). However, the infection was not detected in *R. rossicus* collected from infected *Hemichironius auritus* hedgehogs (Hoogstraal, 1979). Butenko et al. (1971) isolated the virus from engorged *R. rossicus* males parasitic on cattle in Seversky District (Krasnodar Krai, Russia) and from engorged females collected from hedgehogs in Belaya Kalitva (Belokalitvinsky District, Rostov Oblast, Russia). Badalov et al. (1971) found infection with CCHF virus in *R. rossicus* to originate from *Lepus europaeus*.

**West Nile virus**

Although no natural infections with WNV were reported in *R. rossicus*, immature stages of *R. rossicus* were experimentally shown to receive, preserve and trans-stadially maintain the virus (Kotel’nikova & Kondrashova, 1974). Moreover, experimentally infected females were able to transmit the infection to larval offspring via the transovarial route (Kotel’nikova & Kondrashova, 1974). Moreover, experimental infection studies show the capacity of *R. rossicus* to maintain the virus cycle of WNV.

**Other pathogens**

Other pathogens have been sporadically reported from *R. rossicus*, but no further evidence of a vectorial role has been provided. Hence, these associations should be treated cautiously. In 1935, during a mass outbreak of equine theileriosis in Ukraine, horses were found to be massively infected with one single species of tick, namely *R. rossicus* (Kolomiyets, 1936). This seems to be the first circumstantial evidence for the possible vectorial role of *R. rossicus* for *Theileria equi*. Kapustin (1955) also reported *R. rossicus* as a vector for *T. equi* and also *Babesia bigemina*. However, no experimental or other types of proof were provided. Hoogstraal (1979) mentioned the association of *R. rossicus* with *Coxiella burnetii*, but provided no reference.

**Conclusions**

*Rhipicephalus rossicus*, a species with apparently low host specificity and a distribution range largely overlapping the Eurasian steppe, is a neglected tick. Its distribution range may be more extensive than is currently known as a result of its possible misidentification as *R. sanguineus* because the two species may be difficult to distinguish during routine morphological examination. This situation is particularly likely in the case of ticks collected from dogs in areas where the two tick species are sympatric or where *R. sanguineus s.l.* is typically considered to be the only representative of the genus parasitic in canids.

We consider that the vectorial importance of *R. rossicus* may be significantly higher than is currently recognized, mainly because the closely related species *R. sanguineus s.l.* is known to transmit a very wide spectrum of pathogens. It would be particularly interesting to evaluate this hypothesis in areas in which the two species of tick are sympatric or even co-feed on the same host individuals. The probably underestimated vectorial role of *R. rossicus* may represent a hidden public health threat as this tick is occasionally reported to feed on humans.

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